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User's Guide for Phonetic Programming Using the SSI 263A

Phonetics

Every speech sound (phoneme) in any language may be represented by a special symbol (phonetic symbol). These symbols are used in WRITING precisely the sound sequence (phonetic transcription) of a word according to the way it is pronounced. There are many different phonetic symbol sets (phonetic alphabets). Each would contain a minimum number of symbols to represent the basic sounds (phonemes) required to pronounce any word in the language. Additional symbols are usually included which represent sounds with slight to great variations in the basic sounds (allophones). These symbols are used to assist in the transcription of words that reflect a regional, dialectic, or foreign pronunciation.

The process of transcribing a spoken word into its phonetic components begins with identifying the number of sounds in the word, then tagging each with a label to specify its type. Consonants and vowels are the most familiar labels but these may be broken down into subtypes (e.g., stop consonants, back vowels, etc.) as the need for more specificity arises. Once the sounds have been identified, their symbols are selected, then written in sequence. The resulting transcription should allow another person to identify the pronunciation without having heard the word spoken.

Note that when using a phonetic alphabet to transcribe words into their sound sequences, there is not a one-to-one correspondence between the alphabet characters (orthographics) used to spell words and the phonetic symbols (phonetics) used to represent their pronunciations. For example, in the word "phones" there are 6 letters but only 4 sounds. Conversely, the word "I" has 1 letter but 2 sounds. It may be of some assistance to keep a dictionary handy for reference. Dictionaries use their own phonetic system to describe the pronunciations of every word entry. It will be necessary to learn at least one phonetic alphabet in order to engage in phonetic transcription. The SSI 263A Phonetic Alphabet is the referent used in this manual. However, if another system is already known, it is easily translated into the referent.

When transcribing vocabulary from orthography (standard alphabet spelling) to phonetics, it is common to place the phonetic sequence between right slash marks when the transcription appears in running text. The word "phones," for example, would be transcribed as /F O N Z/ when using SSI 263A phonetic symbols. This allows the reader easier identification of phonetic segments.

SSI 263A Phonetic Alphabet

The phonetic alphabet used to represent the SSI 263A phonemes is the SSI 263A PHONETIC ALPHABET. Refer to the Phoneme Chart for a complete listing of the phoneme symbols.

Of the 64 alphanumeric symbols in the SSI 263A Phonetic Alphabet, 34 represent sound BASIC to the pronunciation of American English. The remaining 30 symbols fall into 2 groups: the ALLOPHONE group and the NO-SOUND group. The BASIC sound symbols are:

A, AE, AH, AW, B, D, E, EH, ER, F, HF, I, J, K, KV, L, M, N, NG, O, OO, P, R, S, SCH, T, TH, THV, U, UH, V, W, Y, Z.

Symbols in the ALLOPHONE group represent speech sounds that vary in pronunciation from one of the basic sounds. They may be used in transcribing words or word segments (syllables or morphemes) whose pronunciations are not satisfied by the basic phonemes alone (words rooted in a foreign language, words adapted by a regional dialect, etc.). The ALLOPHONE symbols are:

A1, AE1, AH1, AY, E1, E2, EH1, HN, HV, IE, IU, IU1, L1, LB, LF, OU, R1, R2, U1, UH1, UH2, UH3, Y1, :A, :OH, :U, :UH.

The NO-SOUND symbols represent silent states. One of these symbols represents a "pause" state. It is used to separate phoneme sequences into phrase-like segments which assist in more closely imitating the natural pausing in human speech for breathing or for delayed emphasis. The "pause" is treated as a phoneme when it is selected for a transcription and will be subject to phoneme parameter programming. It has the ability to maintain the parametric levels of duration, inflection, amplitude, etc., during its silence, thus audibly affecting the movement of the preceding and following phonemes. Other NO-SOUND symbols represent "hold" states. They are used in combination with BASIC phonemes or ALLOPHONES to generate articulation variations on their pronunciations. The NO-SOUND symbols are:

HFC, HVC, PA.

Now that there is a tool to use for writing the sounds that are heard, the next stage is to identify the sounds that are produced by the SSI 263A speech synthesizer.

SSI 263A Phoneme Review

Thus far in this program, it has been established that: (1) spoken words are made up of a series of sounds; (2) each speech sound in a language may be represented by an identifying symbol; and (3) the spoken word may be written according to its sound sequence using these special symbols. Before a word may be written phonetically, however, users may wish to study further the SSI 263A speech sounds. What makes one sound different from another and how these differences may be helpful to phonetic programming will be essential information for phonetic programmers.

The sound that is represented by each phonetic symbol in the SSI 263A Phonetic Alphabet must be audibly learned. The easiest way to approach this task is to start with the sounds already known and associate a symbol with them. For example, from spelling we have already learned that vowels may be "long" or "short" and are often differentiated by their particular spelling formats. Every time a word with a "short a" sound is heard (sat, fat, cat, bat, happy, plaster, ankle, Saturday, amplify, contaminate, etc.) the symbol /AE/ should come to mind. A "long a" sound (fate, state, bait, lace, maybe, stable, arrangement, etc.) is actually a diphthong (two sounds combined into a single unit) and may be represented by the symbols /A AY/.

In standard orthography, there are only 5 vowel letters to represent 17 vowel sounds. In phonetics, each vowel sound will be represented by its own symbol or symbol combination.

Again, from spelling, we have learned that the letter "c" may have a hard sound as in "cat" or a soft sound as in "city." The hard sound is actually a /K/ as in "kite" and the soft sound is an /S/ as in "sing." Users must identify which sound (/K/ or /S/) is used in the transcription of a "c." You will not find a symbol C in a phonetic alphabet. Like "C," the letters "O" and "X" will not be found in phonetic alphabets. They are transcribed into the sound sequences /K W/ and /K PA S/. Refer to the Phoneme Chart during this learning period. It provides example words to describe the pronunciations corresponding to each symbol.

Users may add more words to the examples above to continue identifying the symbol-sound relationship for /AE/ and /A AY/. Follow this technique for each symbol in the alphabet. For auditory verification, enter the sound that is being reviewed into the device. Speak aloud your example word for the SSI 263A

sound in an attempt to match that which the synthesizer is emitting.

Example: /E/ = "long e" vowel sound
= meat, read, need, repair, before, phoneme,
erase, brief, people, timeliness, seniority,
receive, catastrophe.

Example: /F/ = "voiceless fricative" consonant
= farm, false, aft, feet, finger, phrase, phone,
Africa, alphabet, cough.

Once you have reviewed auditorily the sounds you already have a familiarity with from spelling, proceed to the BASIC sound list in the above text and continue the review. Be aware that several consonant sounds will not provide output unless they have another sound following. This is the case with /B/, /D/, /P/, /T/, and /K/. When one of these sounds is entered into the SSI 263A, follow it by a vowel and listen to both in sequence.

Users who already have a familiarity with phonetics and SSI 263A synthetic sounds, may wish to follow the sound review procedures in order to auditorily determine the difference between two sounds or identify new ones. For example, enter the /UH/ phoneme into the device. Then enter /UH1/, /UH2/, and /UH3/. Listen to each sound noting the pronunciation variations. Be aware that there are no duplicate sounds resident on the SSI 263A chip.

Whenever a SSI 263A sound is audited that cannot be readily identified as to its appropriate usage, do not be concerned. The review is designed only to provide a method for establishing an auditory memory for each sound and a visual memory for its symbol. Phonetic programming may begin anytime after the initial review. Return to the review later as your familiarity with the BASIC sounds increases and as your need for sound alternatives to those BASIC sounds becomes more apparent.

If there is a question as to which symbols should be chosen to transcribe a word into its sound sequence, make a written note of the word by circling the letter(s) that present the problem. Later, when phonetic programming has begun, a phoneme sequence may be created for the word and users may verify auditorily which phonetic selection produces the most appropriate translation.

SSI 263A Phoneme Discussion

The SSI 263A Phonetic Alphabet is divided into 3 groups for the purpose of differentiating between phonemes and allophones. Another way of dividing the Alphabet is according to usage. The most familiar division is a two sections split: CONSONANT sounds and VOWEL sounds. Within each of these sections, sounds may be further subdivided according to the distinctive features that best describe the sounds phonetically or acoustically. The more that is known about a sound, the easier it is to determine how it may be used in transcribing and phonetically programming a word.

Consonant Sounds

There are 22 Consonant Phonemes, subdivided according to their manner of production in the human speech mechanism. Some are characterized by the noise emitted when the articulators obstruct the air flow (Fricatives like /S/). Vowel-like consonants have the least amount of obstruction and may occasionally be used as a vowel substitute. Stop consonants are obstructed completely, release of air flow occurring at the onset of the next sound. Notice that Affricates are a sequence of 2 sounds (a Stop followed by a Fricative) spoken as a single unit. Unlike vowels, which always have a vocal source during production, consonants may be voiced (V) or unvoiced (U) (no vocal source during air flow). When listening to the manner in which a consonant is produced during speech, note its special characteristics that distinguish it from all other consonants. The figure below displays all of the consonant sounds within their production groups.

| | Stops | Fricatives | Affricates |
|-----------|----------|----------------------|------------|
| Voiced | B, D, KV | Z, V, J, THV | (D, J) |
| Voiceless | P, T, K | S, F, SCH, TH, HF | (T, SCH) |

| | Semi-vowels | Glides | Nasals |
|-----------|-------------|--------|----------|
| Voiced | R, L | W, Y | M, N, NG |
| Voiceless | | | |

Consonant Chart

Voiced and voiceless consonants are subdivided into 6 categories according to the manner in which they are produced in the human vocal tract: i.e., how the air flow is obstructed by the articulators to make each sound different.

Consonant sounds are selected for a sequence in much the same manner as an alphabet character would be selected for the spelling of a word. Users must be alert, however, to identify the exceptions. Occasionally, a consonant appears in the spelling of a word but not in its sound sequence: the "b" in "comb" is not pronounced and the sound sequence reflects the absence of the "b": /K OU M/. Some exceptions have grammatical rules that may be used in determining the appropriate sound. For example, a consonant may have 2 pronunciations according to its sound environment. The "s" used to pluralize the two words that follow are pronounced differently based on whether the sound that precedes it is voiced or unvoiced. An "s" pronunciation will match the voicing characteristics of the sound it follows.

Examples: tips = /T I P S/
tabs = /T AE B Z/

There are other types of consonantal exceptions. For example, the "t" in a word like "nation" is pronounced /SH/ and the program might look like this: nation = /N A AY SH UH3 N/. Users must listen to each word's pronunciation to determine the appropriate phoneme selection.

There are 7 Consonant Allophones, each noted in the table below. The /L/ consonant is used in the initial position of a sequence for words beginning with "L", while the /LF/ allophone will occupy a medial or final position in a sequence: e.g., lull = /L UH LF/. The /LB/ and the /Li/ allophones would be used when a most constricted pronunciation of an "L" was required, as would occur for some words of foreign languages.

| Consonant Phoneme | Consonant Allophones | Consonant Phoneme | Vowel Allophone |
|-------------------|----------------------|-------------------|-----------------|
| L | L1, LB, LF | R | ER |
| R | R1, R2 | Y | YI |

Allophone Listing for /L/, /R/, & /Y/

The /R/ is an initial position phoneme. Both /R1/ and /R2/ have more constricted pronunciations than /R/ and may be used in sequence with soundless interrupts to create a trilled /R/. Often when the /R/ is required in a medial or final position, it is vowelized and the /ER/ is used. Listening to the production of all four of these sounds will auditorily show that they may, occasionally, be used interchangeably.

Examples: red = /R EH D/
bird = /B ER D/
motor = /M OU T ER/

The /Y/ consonant, used as the final sound in words ending with "y," has a vowel allophone that may be used as the initial sound of words starting with "y." Note that both /Y/ and /YI/ are auditorily very close to the /E/ and the /IE/ vowels and may be considered interchangeable.

Vowel Sounds

There are 12 BASIC Vowel Phonemes. Vowels are subdivided according to the manner in which they are produced. All vowels are voiced sounds but each has a different output based on the degree of obstruction created by the opening of the mouth and the tongue position. Lip positions, another obstructing articulator, may range from spread flat to round. While the lips are in any of these positions, the jaw may be simultaneously dropped from a closed to an open position.

| | Front Vowels | Medial Vowels | Back Vowels |
|--------|--------------|---------------|-------------|
| | Spread | | Rounded |
| Closed | E | | U |
| | I | | OO |
| | A | UH | O |
| | EH | (ER) | AW |
| Open | AE | | AH |

Vowel Quadrilateral

Vowels begin their production with the same voiced energy. Changes in the position of the tongue (front or back), the shape of the lips (from spread flat to rounded), and the position of the lower jaw (from closed to open) determine the final characteristics that allow listeners to distinguish between vowel sounds.

Refer to the SSI 263A Phoneme Chart for the pronunciation reference on each BASIC vowel sound. Utilize the sound review techniques on the previous pages to practice identifying the vowel sounds in words and associating them with their phonetic symbols.

The allophonic variations of vowels, 20 in number, are used in a phonetic program to enhance the pronunciation of a word. There are some cases where the allophone is required for articulate pronunciations. This is true for /AY/, /YI/ and /IU/, which are integral components in the phonetic sequences for the "long a" and the varied "long u."

Examples: same = /S A AY M/
you = /YI IU U/

The table below places each allophone into the vowel quadrilateral to demonstrate approximately how they might relate to the BASIC vowels. Users are in no way restricted to traditional phonetic transcriptions that use only the BASIC vowel phonemes. Be encouraged to experiment with allophones. Place them in different positions in a sequence to auditorily check how they effect the overall pronunciation of a word.

| | Front Vowels | Medial Vowels | Back Vowels |
|--------|--------------|---------------|-------------|
| | Spread | | Rounded |
| Closed | YI E1 IE | | U1 |
| | AY | E2 | IU IU1 |
| | A1 | UH1 | OU |
| | EH1 | UH2 | |
| Open | AE1 | UH3 | AH1 |

Allophone Placement In Vowel Quadrilateral

Vowel allophones are placed in the vowel quadrilateral according to their production features. The sounds they emit vary slightly from the BASIC vowels that occupy the same positions.

Four vowel allophones—/A/, /OH/, /U/, and /UH/—are adapted pronunciations of four of the BASIC vowels. These sounds are most commonly used for phonetically programming a foreign word. They may also be used as transitory sounds to link phonemes with opposite production features such as a round, open vowel with a very constricted, narrow consonant.

There are five vowels that require two or more vowel sounds in sequence in order to achieve their pronunciations. These are generally referred to as diphthongs. Refer to the Diphthong Conversion Chart.

The vowel quadrilateral is a handy tool to use for selecting vowel phonemes for diphthongs and other multi-phoneme units. For example, the diphthong in the word "I" starts with an /AH/ and ends with an /E/. In order to move smoothly from the first sound to the second (transition), another vowel may be inserted between these two sounds in sequence. The most likely choice would be a vowel that falls somewhere between /AH/ and /E/ in the quadrilateral: e.g., /UH/, /EH/, /I/, etc. The sequence may look like

this: /AH EH E/ or /AH1 UH3 IE/ or /AH1 EH3 AY/. In their fullest durations, a three-sound sequence would over articulate the diphthong. Shortening the first and last sounds by 1 duration and the medial sound by 2 durations will produce a more acceptable pronunciation (see SSI 263A Phoneme Parameters).

SSI 263A Phoneme Parameters (Attributes)

To achieve an accurate pronunciation of a word produced by the SSI 263A synthesizer requires more than a selection of the appropriate phonemes. Like human speech sounds, synthesized sounds are further defined by the rate at which they are emitted (duration), the level of pitch at which they are emitted (inflection or frequency), and the intensity with which they are produced (amplitude). These are considered the three major speech parameters which give the overall production of a word its linguistic character, transforming simple speech into more complex language. Inflection, amplitude, and duration are only three of the parameters that users have control of during the programming process. The rate at which one sound moves into another (articulation) is also a controllable parameter. Other parameters are: the slope of the inflection (slope), the rate of each selected duration (rate), and the extended inflection frequencies (extension). Users may also select the base frequency at which speech may be produced (filter frequency). Refer to SSI 263A Phoneme Parameters, for the range of each and typical default values selected.

Every phoneme selected for a sequence must be accompanied by assignments for each of the eight parameters. As users become more aware of their need to create different language effects with their synthesized speech output, they will require the flexibility and choice that comes with programmable parameters. For example, with 4 selectable durations per phoneme, each actual pronunciation of each sound may be changed. Thus, every sound has four possible outputs increasing the users' choice from 64 phonemes and allophones to 256. Each of the 256 may be effected differently by each of the 32 possible inflection assignments. Add to these possibilities 16 variations in amplitude and 16 variations in rate. The possible combinations are not limitless, of course, but they are very great and users are encouraged to experiment with as many as possible.

Several of the parameters effect synthetic speech output as a whole. These are articulation, pitch extension, and filter frequency. Users may select a single level at which to set the filter frequency, for example, and maintain that level throughout the programming process.

Phonetic Programming Methodology

Due to the great variety of phonemes and parameter choices, as well as the different effects the parameter selections have on the speech sounds, a systematic approach to selecting the variables is advised. The approach described below is only one of several that might be used. It may be adjusted to accommodate the user's special programming style or to accommodate later implementation of automatic control techniques.

The first step is to transcribe the target word, phrase, etc., into its basic phonetic components. Next, enter these sounds into the SSI 263A and auditorily check the output. Use the default values suggested in the Nominal Phoneme Parameter Table. The results should be a bit stilted if not misarticulated for the first trial program. Phoneme adjustment is next. Continue to make changes in the phoneme sequence, auditorily monitoring the changes, until an adequate pronunciation of the target is established.

Begin parameter adjustments. First, maintain articulation, pitch extension and filter frequency at nominal values. The device should be kept in the transitioned inflection mode. Make adjustments in the levels of only one of the remaining 4 parameters at a time, beginning with the duration and moving on to the inflection, rate, and amplitude (in that order) once the specific effect that the parameter can make has been made. Return to a previously adjusted parameter at any time based on need.

PHONEME CHART

| Hex Code* | Phoneme Symbol | Example Word (or Usage) |
|-----------|----------------|--------------------------|
| 00 | PA | (pause) |
| 01 | E | MEET |
| 02 | E1 | BENT |
| 03 | Y | BEFORE |
| 04 | YI | YEAR |
| 05 | AY | PLEASE |
| 06 | IE | ANY |
| 07 | I | SIX |
| 08 | A | MADE |
| 09 | AI | CARE |
| 0A | EH | NEST |
| 0B | EH1 | BELT |
| 0C | AE | DAD |
| 0D | AE1 | AFTER |
| 0E | AH | GOT |
| 0F | AH1 | FATHER |
| 10 | AW | OFFICE |
| 11 | O | STORE |
| 12 | OU | BOAT |
| 13 | OO | LOOK |
| 14 | IU | YOU |
| 15 | IU1 | COULD |
| 16 | U | TUNE |
| 17 | U1 | CARTOON |
| 18 | UH | WONDER |
| 19 | UH1 | LOVE |
| 1A | UH2 | WHAT |
| 1B | UH3 | NUT |
| 1C | ER | BIRD |
| 1D | R | ROOF |
| 1E | R1 | RUG |
| 1F | R2 | MUTTER (German) |
| 20 | L | LIFT |
| 21 | L1 | PLAY |
| 22 | LF | FALL (final) |
| 23 | W | WATER |
| 24 | B | BAG |
| 25 | D | PAID |
| 26 | KV | TAG (glottal stop) |
| 27 | P | PEN |
| 28 | T | TART |
| 29 | K | KIT |
| 2A | HV | (hold vocal) |
| 2B | HVC | (hold vocal closure) |
| 2C | HF | HEART |
| 2D | HFC | (hold fricative closure) |
| 2E | HN | (hold nasal) |
| 2F | Z | ZERO |
| 30 | S | SAME |
| 31 | J | MEASURE |
| 32 | SCH | SHIP |
| 33 | V | VERY |
| 34 | F | FOUR |
| 35 | THV | THERE |
| 36 | TH | WITH |
| 37 | M | MORE |
| 38 | N | NINE |
| 39 | NG | RANG |
| 3A | :A | MARCHEN (German) |
| 3B | :OH | LOWE (French) |
| 3C | :U | FUNF (German) |
| 3D | :UH | MENU (French) |
| 3E | E2 | BITTE (German) |
| 3F | LB | LUBE |

SSI 263A Diphthong Conversion Chart

| Phoneme Sequence | Example Words |
|----------------------|---------------------|
| A AY Y | rain, became, stay |
| A IE EH1 UH3 LF | mail, hale, avail |
| AH1 AE1 EH1 Y | time, rhyme, sky |
| AH1 EH1 IE AW UH3 LF | smile, style, while |
| AH1 EH1 IE UH3 ER | fire, liar, inspire |
| UH3 AH1 Y | mice, right, sniper |
| O U | road, stone, lower |
| OU O O | tore, four, floor |
| AH1 AW O U | loud, flower, hour |
| UH3 AH1 O U | house, about, ouch |
| O UH1 AH1 I IE | boy, noise, annoy |
| O UH3 EH1 I OO LF | boil, spoil, doily |
| IU U U | tune, spoon, do |
| YI IU U U | you, few, music |

SSI 263A Multi-Unit Conversion Chart

| Phoneme Sequence | Example Words |
|------------------|--------------------|
| T HFC SCH | church, latch |
| KV HVC HF | good, lag, angry |
| D J | just, ledge, wage |
| KV HF HFC | lake, corn, check |
| P HF | pipe, pay, poor |
| K HF W | quest, quick, aqua |
| T HF | top, trip, strain |
| HFC K HF HVC S | six, exit, taxi |

Nominal Phoneme Parameter Table (Suggested Default Values for Speech Development)

Amplitude (A3 → A0)

Range—0 to F (softest to loudest, 0 = silent)

Default—C

Exceptions—KV = 0, B = D = 6

Duration (DR1, DR0)

Range—3 to 0 (shortest to longest)

Default—0

Filter Frequency Range (F7 → F0)

Range—00 to FF (lowest to highest)

Default—E9

Inflection (Pitch) (I10 → I6, Transitioned Inflection Mode Only)

Range—0 to 1F (lowest to highest, 0 = silent)

Default—04

Extension and Range of Pitch (I11, I2 → I0)

Range—0 to 7 (low); 8 to F (high)

Default Value—8

Rate of Speech (R3 → R0)

Range—0 to F (slowest to fastest)

Default—A

Slope of Inflection (I6 → I3, Transitioned Inflection Mode Only)

Range—0 to 7

Default—0

Articulation (Rate of) (A3 → A0)

Range—0 to 7 (slow to fast)

Default—5

*Note — Hex codes shown with DR0, DR1 = 0 (longest Duration)

Example of Using Phonetic Programming Methodology:

Developing "Hello"

| Phoneme Parameters | | | | | | | | | | SSI 263 Register Data | | | | | | | | | |
|--------------------------------------|--|--|--|--|--|--|--|--|--|-----------------------|--|--|--|--|--|--|--|--|--|
| Pho.D T In—S A R E FF | | | | | | | | | | DP IS RE TA FF | | | | | | | | | |
| KEY: | | | | | | | | | | | | | | | | | | | |
| Pho = Phoneme | | | | | | | | | | | | | | | | | | | |
| D = Duration | | | | | | | | | | | | | | | | | | | |
| T = Articulation | | | | | | | | | | | | | | | | | | | |
| In = Inflection | | | | | | | | | | | | | | | | | | | |
| S = Slope of Inflection | | | | | | | | | | | | | | | | | | | |
| A = Amplitude | | | | | | | | | | | | | | | | | | | |
| R = Rate | | | | | | | | | | | | | | | | | | | |
| E = Extension and Range of Pitch | | | | | | | | | | | | | | | | | | | |
| FF = Filter Frequency | | | | | | | | | | | | | | | | | | | |
| DP = Duration/Phoneme Register | | | | | | | | | | Address 000 | | | | | | | | | |
| IS = Inflection/Slope Register | | | | | | | | | | 001 | | | | | | | | | |
| RE = Rate/Extension Register | | | | | | | | | | 010 | | | | | | | | | |
| TA = Articulation/Amplitude Register | | | | | | | | | | 011 | | | | | | | | | |
| FF = Filter Frequency Register | | | | | | | | | | 1XX | | | | | | | | | |

1. Original Phoneme Entry:

| Pho.D T | In-S | A | R | E | FF | DP | IS | RE | TA | FF |
|---------|------|---|---|---|----|----|----|----|----|----|
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| HF .0 5 | 0A-0 | C | A | 8 | E9 | 2C | 50 | A8 | 5C | E9 |
| EH .0 5 | 0A-0 | C | A | 8 | E9 | 0A | 50 | A8 | 5C | E9 |
| L .0 5 | 0A-0 | C | A | 8 | E9 | 20 | 50 | A8 | 5C | E9 |
| O .0 5 | 0A-0 | C | A | 8 | E9 | 11 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |

2. Phoneme Selection Refinement

| Pho.D T | In-S | A | R | E | FF | DP | IS | RE | TA | FF |
|----------|------|---|---|---|----|----|----|----|----|----|
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| HF .0 5 | 0A-0 | C | A | 8 | E9 | 2C | 50 | A8 | 5C | E9 |
| EH .0 5 | 0A-0 | C | A | 8 | E9 | 0A | 50 | A8 | 5C | E9 |
| UH3 .0 5 | 0A-0 | C | A | 8 | E9 | 1B | 50 | A8 | 5C | E9 |
| LF .0 5 | 0A-0 | C | A | 8 | E9 | 22 | 50 | A8 | 5C | E9 |
| UH3 .0 5 | 0A-0 | C | A | 8 | E9 | 1B | 50 | A8 | 5C | E9 |
| O .0 5 | 0A-0 | C | A | 8 | E9 | 11 | 50 | A8 | 5C | E9 |
| OU .0 5 | 0A-0 | C | A | 8 | E9 | 12 | 50 | A8 | 5C | E9 |
| U .0 5 | 0A-0 | C | A | 8 | E9 | 16 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |

3. Duration Adjustment

| Pho.D T | In-S | A | R | E | FF | DP | IS | RE | TA | FF |
|----------|------|---|---|---|----|----|----|----|----|----|
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| HF .1 5 | 0A-0 | C | A | 8 | E9 | 6C | 50 | A8 | 5C | E9 |
| EH .0 5 | 0A-0 | C | A | 8 | E9 | 0A | 50 | A8 | 5C | E9 |
| UH3 .2 5 | 0A-0 | C | A | 8 | E9 | 9B | 50 | A8 | 5C | E9 |
| LF .0 5 | 0A-0 | C | A | 8 | E9 | 22 | 50 | A8 | 5C | E9 |
| UH3 .2 5 | 0A-0 | C | A | 8 | E9 | 9B | 50 | A8 | 5C | E9 |
| O .2 5 | 0A-0 | C | A | 8 | E9 | 91 | 50 | A8 | 5C | E9 |
| OU .0 5 | 0A-0 | C | A | 8 | E9 | 12 | 50 | A8 | 5C | E9 |
| U .3 5 | 0A-0 | C | A | 8 | E9 | D6 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |

4. Phoneme and Duration Adjustment

| Pho.D T | In-S | A | R | E | FF | DP | IS | RE | TA | FF |
|----------|------|---|---|---|----|----|----|----|----|----|
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| HF .1 5 | 0A-0 | C | A | 8 | E9 | 6C | 50 | A8 | 5C | E9 |
| EH1 .1 5 | 0A-0 | C | A | 8 | E9 | 4B | 50 | A8 | 5C | E9 |
| UH3 .2 5 | 0A-0 | C | A | 8 | E9 | 9B | 50 | A8 | 5C | E9 |
| LF .0 5 | 0A-0 | C | A | 8 | E9 | 22 | 50 | A8 | 5C | E9 |
| UH3 .2 5 | 0A-0 | C | A | 8 | E9 | 9B | 50 | A8 | 5C | E9 |
| O .2 5 | 0A-0 | C | A | 8 | E9 | 91 | 50 | A8 | 5C | E9 |

| | | | | | | | | | | |
|---------|------|---|---|---|----|----|----|----|----|----|
| OU .0 5 | 0A-0 | C | A | 8 | E9 | 12 | 50 | A8 | 5C | E9 |
| U .2 5 | 0A-0 | C | A | 8 | E9 | 96 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |

5. Inflection Adjustment

| Pho.D T | In-S | A | R | E | FF | DP | IS | RE | TA | FF |
|----------|------|---|---|---|----|----|----|----|----|----|
| PA .0 5 | 0B-0 | C | A | 8 | E9 | 00 | 58 | A8 | 5C | E9 |
| PA .0 5 | 0B-0 | C | A | 8 | E9 | 00 | 58 | A8 | 5C | E9 |
| HF .1 5 | 0A-0 | C | A | 8 | E9 | 6C | 50 | A8 | 5C | E9 |
| EH1 .1 5 | 0B-0 | C | A | 8 | E9 | 4B | 40 | A8 | 5C | E9 |
| UH3 .2 5 | 09-0 | C | A | 8 | E9 | 9B | 48 | A8 | 5C | E9 |
| LF .0 5 | 0B-0 | C | A | 8 | E9 | 22 | 40 | A8 | 5C | E9 |
| UH3 .2 5 | 05-0 | C | A | 8 | E9 | 9B | 28 | A8 | 5C | E9 |
| O .2 5 | 05-0 | C | A | 8 | E9 | 91 | 28 | A8 | 5C | E9 |
| OU .0 5 | 06-0 | C | A | 8 | E9 | 12 | 30 | A8 | 5C | E9 |
| U .2 5 | 07-0 | C | A | 8 | E9 | 96 | 38 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |
| PA .0 5 | 0B-0 | C | A | 8 | E9 | 00 | 58 | A8 | 5C | E9 |

6. Phoneme, Duration, Inflection, and Rate Adjustment

| Pho.D T | In-S | A | R | E | FF | DP | IS | RE | TA | FF |
|----------|------|---|---|---|----|----|----|----|----|----|
| PA .0 5 | 0B-0 | C | A | 8 | E9 | 00 | 58 | A8 | 5C | E9 |
| PA .0 5 | 0B-0 | C | A | 8 | E9 | 00 | 58 | A8 | 5C | E9 |
| HF .1 5 | 0A-0 | C | 7 | 8 | E9 | 6C | 50 | 78 | 5C | E9 |
| EH1 .1 5 | 0B-0 | C | D | 8 | E9 | 4B | 40 | D8 | 5C | E9 |
| UH3 .2 5 | 09-0 | C | C | 8 | E9 | 9B | 48 | C8 | 5C | E9 |
| LF .0 5 | 0B-0 | C | C | 8 | E9 | 22 | 40 | C8 | 5C | E9 |
| UH3 .2 5 | 05-0 | C | 9 | 8 | E9 | 9B | 28 | 98 | 5C | E9 |
| O .2 5 | 05-0 | C | 9 | 8 | E9 | 91 | 28 | 98 | 5C | E9 |
| OU .0 5 | 06-0 | C | A | 8 | E9 | 12 | 30 | A8 | 5C | E9 |
| U .2 5 | 07-0 | C | C | 8 | E9 | 96 | 38 | C8 | 5C | E9 |
| U .3 5 | 0A-0 | C | 7 | 8 | E9 | D6 | 50 | 78 | 5C | E9 |
| PA .0 5 | 0B-0 | C | A | 8 | E9 | 00 | 58 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |

7. Phoneme, Duration, Inflection, Rate, and Amplitude Adjustment

| Pho.D T | In-S | A | R | E | FF | DP | IS | RE | TA | FF |
|----------|------|---|---|---|----|----|----|----|----|----|
| PA .0 5 | 0B-0 | C | A | 8 | E9 | 00 | 58 | A8 | 5C | E9 |
| PA .0 5 | 0B-0 | C | A | 8 | E9 | 00 | 58 | A8 | 5C | E9 |
| EH .0 5 | 07-0 | 0 | D | 8 | E9 | 0A | 38 | D8 | 50 | E9 |
| HF .1 5 | 0A-0 | 4 | 7 | 8 | E9 | 6C | 50 | 78 | 54 | E9 |
| EH1 .1 5 | 0B-0 | C | D | 8 | E9 | 4B | 40 | D8 | 5C | E9 |
| UH3 .2 5 | 09-0 | A | C | 8 | E9 | 9B | 48 | C8 | 5A | E9 |
| LF .0 5 | 0B-0 | A | C | 8 | E9 | 22 | 40 | C8 | 5A | E9 |
| UH3 .2 5 | 05-0 | C | 9 | 8 | E9 | 9B | 28 | 98 | 5C | E9 |
| O .2 5 | 05-0 | C | 9 | 8 | E9 | 91 | 28 | 98 | 5C | E9 |
| OU .0 5 | 06-0 | C | A | 8 | E9 | 12 | 30 | A8 | 5C | E9 |
| U .2 5 | 07-0 | A | C | 8 | E9 | 96 | 38 | C8 | 5A | E9 |
| U .3 5 | 0A-0 | 0 | 7 | 8 | E9 | D6 | 50 | 78 | 50 | E9 |
| PA .0 5 | 0B-0 | C | A | 8 | E9 | 00 | 58 | A8 | 5C | E9 |
| PA .0 5 | 0A-0 | C | A | 8 | E9 | 00 | 50 | A8 | 5C | E9 |

8. Further Adjustment (depending on personal preference)

| Pho.D T | In-S | A | R | E | FF | DP | IS | RE | TA | FF |
|----------|------|---|---|---|----|----|----|----|----|----|
| PA .0 5 | 0D-0 | C | A | 8 | E9 | 00 | 68 | A8 | 5C | E9 |
| PA .0 5 | 0D-0 | C | A | 8 | E9 | 00 | 68 | A8 | 5C | E9 |
| EH .0 5 | 0D-0 | 0 | D | 8 | E9 | 0A | 68 | D8 | 50 | E9 |
| HF .1 5 | 07-0 | 2 | 8 | 8 | E9 | 6C | 38 | 88 | 52 | E9 |
| EH1 .1 5 | 09-2 | C | D | 8 | E9 | 4B | 4A | D8 | 5C | E9 |
| UH3 .2 5 | 09-4 | A | C | 8 | E9 | 9B | 4C | C8 | 5A | E9 |
| LF .0 5 | 09-0 | A | C | 8 | E9 | 22 | 48 | C8 | 5A | E9 |
| UH3 .2 5 | 07-7 | C | 9 | 8 | E9 | 9B | 3F | 98 | 5C | E9 |
| O .2 5 | 06-4 | C | 9 | 8 | E9 | 91 | 34 | 98 | 5C | E9 |
| OU .1 5 | 05-2 | C | A | 8 | E9 | 52 | 2A | A8 | 5C | E9 |
| U .2 5 | 06-3 | 3 | 5 | 8 | E9 | 96 | 33 | 58 | 53 | E9 |
| U .3 5 | 07-4 | 0 | C | 8 | E9 | D6 | 3C | C8 | 50 | E9 |
| PA .0 5 | 05-4 | C | C | 8 | E9 | 00 | 2C | C8 | 5C | E9 |
| PA .0 5 | 01-4 | C | C | 8 | E9 | 00 | 0C | C8 | 5C | E9 |